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Effect of tillage and nutrient management practices on soil properties and yield of rainfed groundnut

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ABSTRACT

The effect of tillage and nutrient management practices on soil properties and yield of groundnut (*Arachis hypogaea* L.) under rainfed condition were evaluated on a sandy loam soil of University of Agricultural Sciences, GKVK, Bangalore during *Kharif* 2007. The study indicated that, mechanical tillage practices were found superior to conventional tillage. Mechanical tillage + two intercultivations at 25 and 45 days after sowing registered higher pod yield (1307 kg ha^{-1}), organic carbon, available N, available P_2O_5 and available K_2O and lower bulk density and penetration resistance (1.3 g cm^{-3} and 1.44 kg cm^{-2}, respectively) and higher water holding capacity and porosity (42.7 and 49.2%, respectively) were recorded with mechanical tillage + two intercultivations. Application of 50 per cent organic manure + 50 per cent inorganic fertilizers recorded highest pod yield of 1282 kg ha^{-1} and also noticed the better soil physico-chemical properties.

Key words : Bulk density, Tillage, Penetration resistance, Porosity

INTRODUCTION

Groundnut (*Arachis hypogaea* L.) is cultivated in tropical and sub-tropical countries. Brazil in South America is considered to be the country of its origin. Groundnut primarily cultivated in USA, Senegal, Sudan, China, West Africa, Indonesia and India. India is the largest producer of groundnut and it is predominantly grown in Royalseema area of Andhra Pradesh, Saurashtra in Gujarat, parts of Tamil Nadu, Karnataka, Orissa and Maharashtra, Madhya Pradesh and Rajasthan. These states contribute 96% of total area and production. Karnataka stands fourth with an area of 10.4 lakh ha with annual production of 6.71 lakh tonnes and average productivity of 679 kg ha^{-1} (Anonymous, 2007). The crop is mainly grown in *Kharif* under rainfed conditions. However in southern and western India, cultivation of *Rabi* groundnut is picking up. The groundnut seed is valued both for its oil and protein content. In India groundnut oil is popularly used for cooking purpose. Tilling of soil has been considered as one of the important soil management practice adopted for ensuring proper soil health. For optimum germination and growth, the soil must optimally supply water, oxygen, nutrients and heat, additionally the soil must be loose enough to allow root penetration and seedling emergence. Tillage helps to improve looseness, oxygen supplies and water intake among other things (Donahue *et al*., 1987). Tillage has major influence on soil bulk density, penetration resistance, water intake, storage and extraction of water from the soil by the plant roots and on the microbial activity which influences soil aeration, moisture and temperature (Tripathi *et al*., 2007).

India has made spectacular breakthrough in production and consumption of fertilizers during last four decades. Because of escalating energy cost, chemical fertilizers are not available at affordable prices to the farmers. Integrated use of both chemical fertilizers and organic manures is needed to check the depletion of soil and enhance the yield levels. The importance of organic manures in promoting soil health and better plant nutrition has started receiving much recognition in the world as a whole in recent years. The supplementary and complementary use of organic manures along with chemical fertilizers, besides improving physico-chemical properties also improves the use efficiency of applied fertilizers. Keeping these points in view, a field experiment was conducted to know the effect of tillage and nutrient management practices on soil properties and yield of groundnut (*Arachis hypogaea* L.) under rainfed condition.

MATERIALS AND METHODS

A field investigation was conducted during *Kharif* season of 2007 in red sandy loam (Alfisol) soil in Agronomy Field Unit, University of Agricultural Sciences, GKVK, Bangalore. The pH of the soil was 6.6, EC 0.15 dS m^{-1}, available N (189.6 kg ha^{-1}), available P_2O_5 (29.3 kg ha^{-1}), available K_2O (202.8 kg ha^{-1}) and organic carbon (0.56%). The experiment was laid out in a split plot design assigning four tillage practices to main plots *viz.,* T_1: Conventional tillage (bullock drawn desi plough twice + bullock drawn cultivator twice) + one intercultivation @ 25 days after sowing (DAS), T_2: Conventional tillage +

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two intercultivations @ 25 and 40 DAS, T_3: Mechanical tillage (tractor drawn disc plough once + tractor drawn cultivator twice) + one intercultivation @ 25 DAS and T_4: Mechanical tillage + two intercultivations @ 25 and 40 DAS and three nutrient management practices to sub plots *viz.*, F_1: 100% organics (FYM @ 25 kg N equivalent), F_2: 100 % inorganics (25:50:25 N, P_2O_5, K_2O kg ha^{-1}) and F_3: 50% organics (FYM @ 12.5 kg N equivalent) + 50% inorganics (12.5:25:12.5 N, P_2O_5, K_2O kg ha^{-1}) with three replications. The groundnut variety TMV-2, was sown on last week of July with a spacing of 30 cm x 15 cm during 2007.

Changes in soil physical environment at surface (0-20 cm) were monitored in terms of bulk density, water holding capacity, porosity and penetration resistance was recorded at 45 DAS. Bulk density (g cm^{-3}), water holding capacity (%) and porosity (%) of soil was determined by Keen's cup method developed by Keen and Raczkowski (1921) and penetration resistance (kg cm^{-2}) was determined by pocket penetrometre.

RESULTS AND DISCUSSION

The results obtained from the present investigation have been presented under in the following sub heads:

Physical properties of soil :

Studies with various tillage and nutrient management practices were significantly influenced on physical properties of soil, but none of interactions were found to be significant (Table 1). The results indicated that, lower bulk density and penetration resistance (1.30 g cm^{-3} and 1.44 kg cm^{-2}, respectively) and higher water holding capacity and porosity of soil (42.7 and 49.2%, respectively) at 45 DAS were observed with mechanical tillage + two intercutivations @ 25 and 40 DAS as compared to other tillage practices. This might be due to maximum disturbance of soil by mechanical tillage and with further disturbance by interculturing at @ 25 and 40 DAS resulted in increased soil volume associated higher microspore space and reduced the soil compaction. These results are in conformity with the findings of Jayasree *et al.* (2005) and Rosegrant *et al.* (2002). Application of 100 per cent organics (FYM) observed lower bulk density at 45 DAS (1.34 g cm^{-3}) and penetration resistance (1.77 kg cm^{-2}) and higher water holding capacity (41.9%) and porosity (46.8%), which was closely followed by 50 per cent organics + 50 per cent inorganics. Application of FYM looses the soil resulting in increased soil volume thereby it reduced the soil compaction. All these favourable physical condition contributed towards good yields of groundnut with application of FYM + inorganic fertilizers. These results are in conformity with Bellakki and Badanur (1997). Similarly, Deshmukh *et al.* (2007) observed that bulk density values were found statistically significant under different treatments of organic and fertilizers and it varied over a range of 1.35 to 1.59 mg m^{-3} with lowest values under the treatment of 50 per cent recommended NPK through inorganic fertilizer + 50 per cent N through FYM. Whereas soil porosity was found highest (48.95%) under the treatment of 50 per cent recommended NPK through inorganic fertilizer + 50 per cent N through FYM.

Table 1 : Effect of various tillage and nutrient management practices on soil physical properties

Treatments	Bulk density (g cm^{-3})	WHC (%)	Porosity (%)	Penetration resistance (kg cm^{-2})
Tillage Practices (T)				
T_1 : Conventional tillage + one intercultivation	1.44	37.7	42.0	2.44
T_2 : Conventional tillage + two intercultivations	1.41	40.3	43.9	2.02
T_3 : Mechanical tillage + one intercultivation	1.34	41.4	46.8	1.58
T_4: Mechanical tillage + two intercultivations	1.30	42.7	49.2	1.44
S.E.±	0.006	0.21	0.24	0.013
C.D. (P= 0.05)	0.020	0.72	0.83	0.044
Nutrient management practices (F)				
F_1: 100% organics	1.34	41.9	46.8	1.77
F_2: 100% inorganics	1.41	39.4	43.7	1.97
F_3: 50% organics + 50% inorganics	1.36	40.4	45.9	1.87
S.E.±	0.005	0.10	0.20	0.010
C.D. (P= 0.05)	0.014	0.30	0.59	0.028
Interaction (TxF)	NS	NS	NS	NS

NS- Non significant; WHC- Water holding capacity

Table 2 : Organic carbon (%), NPK availability (kg ha^{-1}) in soil after harvest and pod yield of groundnut (kg ha^{-1}) as affected by various tillage and nutrient management practices

Treatments	OC %	N (kg ha^{-1})	P_2O_5 (kg ha^{-1})	K_2O (kg ha^{-1})	Pod yield (kg ha^{-1})
Tillage Practices (T)					
T_1 : Conventional tillage + one intercultivation	0.62	187.9	28.91	192.1	1081
T_2 : Conventional tillage + two intercultivations	0.60	189.6	31.22	200.0	1153
T_3 : Mechanical tillage + one intercultivation	0.59	193.7	34.38	208.3	1215
T_4: Mechanical tillage + two intercultivations	0.57	195.7	35.88	214.8	1307
S.E.±	0.005	0.62	0.49	1.13	6.90
C.D. (P= 0.05)	0.018	2.16	1.71	3.92	23.90
Nutrient management practices (F)					
F_1: 100% organics	0.65	193.6	32.88	204.2	1089
F_2: 100% inorganics	0.54	186.5	30.46	199.5	1196
F_3: 50% organics + 50% inorganics	0.59	195.1	34.46	207.6	1282
S.E.±	0.004	0.86	0.41	1.02	7.0
C.D. (P= 0.05)	0.013	2.58	1.23	3.07	21.0
Interaction (TxF)	NS	NS	NS	NS	NS

NS- Non significant

Chemical properties of soil :

The chemical properties of soil were also influenced by various tillage and nutrient management practices in groundnut (Table 2). Among tillage practices, greater improvement in organic carbon content of soil was recorded with conventional tillage + one intercultivation (0.62%) as compared to all other tillage practices. However, lower organic carbon was observed with mechanical tillage + two intercultivations (0.57%). This might be due to deep tillage by tractor drawn disc plough associated with maximum disturbance of soil which enhanced the oxidation processes in soil there by lower the organic carbon status in soil. However, mechanical tillage + two intercultivations recorded higher availability N, P_2O_5 and K_2O after harvest of groundnut (195.7, 35.88 and 214.8 kg ha^{-1}) over other tillage practices and which was at par with that of mechanical tillage + one intercultivation except K_2O availability. These results are in conformity with the findings of Vijay Kumar *et al.* (1999). Among nutrient management practices, the increase in organic carbon content of soil was recorded with 100 per cent organics (0.65%) followed by combined application of 50 per cent organics + 50 per cent inorganics (0.59%). However, combined application of 50 per cent organics + 50 per cent inorganics recorded higher availability N, P_2O_5 and K_2O after harvest of groundnut (195.1, 34.46 and 207.6 kg ha^{-1}) over other treatments. These results are in conformity with the findings of Bajpai *et al*. (2006). However, the interaction effect were found to be non significant.

Yield of groundnut :

Significant differences in pod yield ha^{-1} of groundnut were observed due to various tillage and nutrient management practices, but interaction of between tillage and nutrient management practices were shown non significant (Table 2). Higher pod yield of groundnut was recorded with mechanical tillage + two intercultivations and application of 50 per cent organics + 50 per cent inorganics (1307 and 1282 kg ha^{-1}, respectively) as compared to other treatments. This might be due to better physico-chemical properties in terms of bulk density, water holding capacity, soil strength and more availability of nutrients and also due to higher yield attributes and ultimately resulted higher pod yield of groundnut. These results are in conformity with Vijay Kumar *et al.* (1999) and Seshadri Reddy *et al.* (2005).

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